

POSITION OF "*LEUCTRA*" *DIVISA* HITCHCOCK WITHIN THE FAMILY LEUCTRIDAE (PLECOPTERA)^{1 2}

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ABSTRACT: The holotype male of "*Leuctra*" *divisa* Hitchcock is redescribed and refigured. Examination of the holotype indicates that the proper taxonomic assignment of this species is to a group of closely related species within the genus *Paraleuctra* which includes *P. sara*, *P. forcipata*, *P. vershina*, *P. purcellana*, *P. orientalis*, *P. zapekinae*, and *P. cercia*. Characters serving to distinguish *P. divisa* from the other species within this group are discussed. A preliminary analysis of the phyletic relationships of all the certain species belonging to this genus is depicted in the form of a computer-generated minimum spanning tree.

DESCRIPTORS: Plecoptera; Leuctridae; *Paraleuctra*; "*Leuctra*" *divisa* Hitchcock; holotype male redescribed.

"*Leuctra*" *divisa* was described by Hitchcock (1958) from a single adult male specimen. Unfortunately, in his description Hitchcock concentrated on genitalic structures and omitted detailed mention of prothoracic sternal and wing venational characteristics, two anatomical criteria which had been used by previous workers (Hanson, 1941; Ricker, 1943) in assigning species to their proper taxonomic group within the Leuctridae. Nonetheless, Hitchcock noted that "*L.*" *divisa* was clearly distinct and that it could possibly be a representative of a new and undescribed subgenus in addition to those already recognized within the genus *Leuctra* (s.l.). Subsequently Illies (1966) elevated the subgenera within *Leuctra* (s.l.) to generic status, but retained Hitchcock's species within *Leuctra* (s.s.). However, Ricker and Ross (1969) and Nelson and Hanson (1973) in their respective studies on leuctrid phylogeny treated "*L.*" *divisa* as not belonging to *Leuctra* (s.s.) but as a representative of its own separate group. Yet neither set of authors undertook any formal nomenclatural changes and, as recently noted by Zwick (1977), the precise placement of this species within the Leuctridae still remained unclear. In view of the uncertain placement of "*L.*" *divisa* and its possible importance in clarifying the phylogeny of the Leuctridae, an examination of the holotype was carried out. This examination has revealed that while this species has

¹ Accepted for publication: June 11, 1977

² Research reported in this study partially supported by a University of Chattanooga Foundation Grant. Published with the aid of funds from the University of Tennessee, Chattanooga.

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been incorrectly assigned to *Leuctra* (s.s.) there is, on the other hand, no basis currently for erecting a new genus within the Leuctridae for its inclusion.

Paraleuctra divisa (Hitchcock), New Combination

Adult Male. — Body length and coloration as described by Hitchcock (1958).

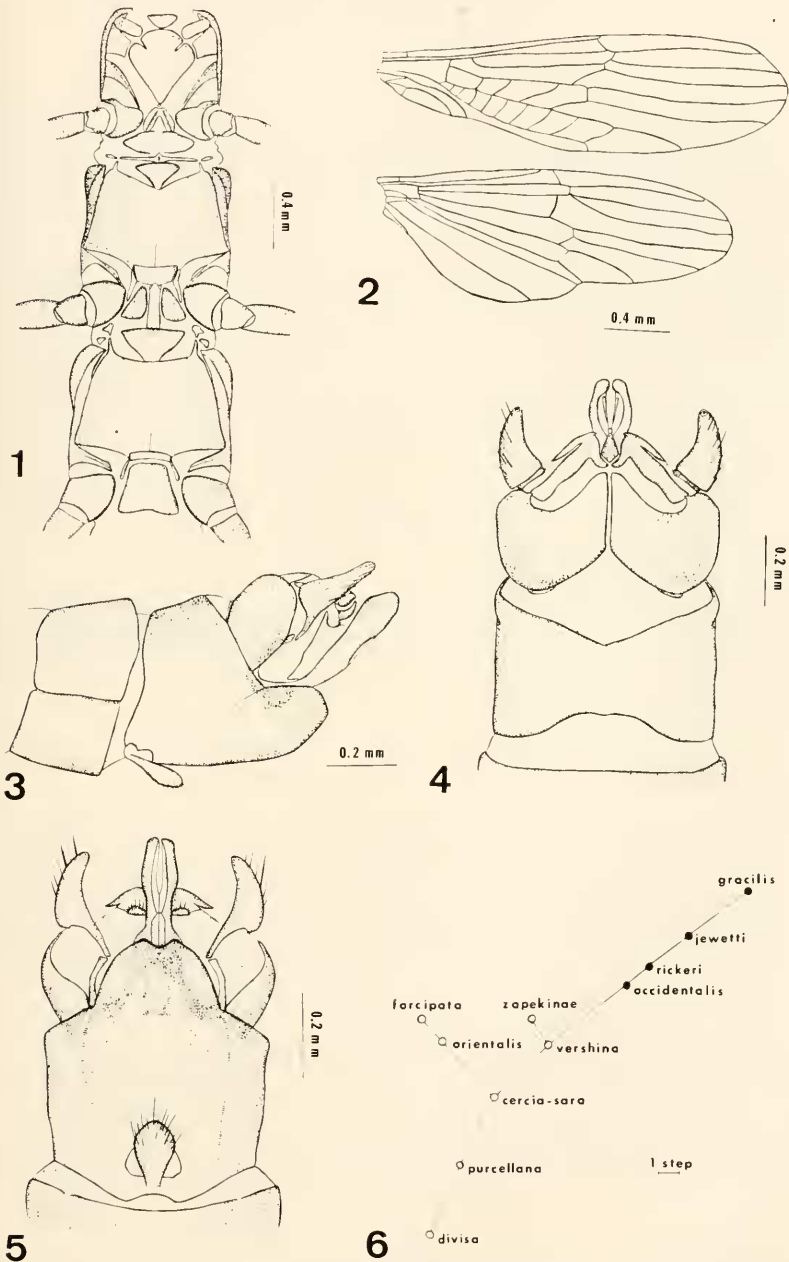
Prothoracic basisternum anteriorly partially fused to presternum and posteriorly fused to furcasternum (Fig. 1.).

Rs and M of forewing originate from separate points on R (Fig. 2). On hindwing Rs and M originate from separate points on arculus; M_{3+4} arises from M; m - cu crossvein distal to position of r - m crossvein and anal veins number three.

Pregenital abdominal tergites all entirely sclerotized dorsally. Ninth sternite with moderately produced vesicle (Fig. 5) arising from antero-medial sternal region. Subgenital plate posteriorly produced and emarginate. Tenth tergite with meso-posterior border produced posteriorly (Fig. 4). Tergite divided meso-dorsally for all of its longitudinal distance by narrow membranous strip. Tenth sternite incomplete ventrally (Fig. 5). Epiproct (Fig. 4) moderate in size and in lateral view (Fig. 3) curved, narrowing gradually from its base to a point apically. Epiproct situated underneath and anterior to the meso-posterior margin of tenth tergite. "Lateral bars" (Fig. 4) articulate with epiproct at their posterior extremities. Outer-lobes of paraproct (Fig. 3, 5) modified into elongate, narrow belt-like "suspensory bars" (Ricker and Ross, 1969). Each outer-lobe articulates at its basal extremity with the cercus. When viewed laterally each outer-lobe distally is somewhat club-shaped and covered on its antero-lateral surface with many small protuberances. Attachment bulb of paraproct (Zwick, 1973) small, half sclerotized and half membranous (Fig. 3, 5). Cercus of each side (Figs. 4, 5) broadest basally and narrowing to a bluntly pointed apex. Cercus, lacking spines and protuberances, apically bearing a small "rounded" sclerite, very likely representing remainder of second cercal segment.

Material Examined. — Holotype Male, Woodacre, Marin Co., California, IV-14-1956. S.W. Hitchcock. California Academy of Science, Type #9998.

Paraleuctra divisa shares with the other members of the genus the following combinations of features; (1) prothoracic presternum partially fused to basisternum, (2) prothoracic furcasternum fused to basisternum, (3) m-cu crossvein of hindwing distal to r-m crossvein, (4) outer-lobes of paraproct elongate, narrow "suspensory bars", and (5) mesobasal margin of each cercus expanded into a narrow, elongate belt-like extension. Within *Paraleuctra* this species is apparently closely related to a group of species in which the males are characterized by; (1) relatively short length of the distal region of the outer lobes of the paraproct, less than twice the length of the mesolongitudinal distance of the ninth sternite, and (2) absence of a distinctly expanded apical area of the distal region of the outer lobes. In addition to *P. divisa* members of this group include: *P. sara* (Claassen), *P. forcipata* (Frison), *P. purcellana* (Neave), *P. vershina* Gaufin and Ricker - North America; *P. orientalis* (Chu) - China; *P. cercia* (Okomato) - Japan; *P. zapikinae* Zhiltozova - USSR.



Figs. 1-5. *Paraleuctra divisa* (Hitchcock). Fig. 1. Thoracic sternite. Fig. 2. Wings. Fig. 3. Male terminalia, lateral view. Fig. 4. Male terminalia, dorsal view. Fig. 5. Male terminalia, ventral view. Fig. 6. Minimum spanning tree for the species of *Paraleuctra*. Length of internodes proportional to phenetic distance.

A preliminary estimate of the phyletic relationships between all the certain species within *Paraleuctra* can be carried out utilizing the procedure for constructing a minimum spanning tree described by Farris (1970). Characteristics of the cerci and paraproct which have been chiefly relied upon in past studies for distinguishing between species in this group are employed in this present study and are arranged in a data matrix (Table 1). Unfortunately, specimens representing all the species in this group were not available for examination. Nonetheless, a data matrix based on characteristics of the cerci and paraproct could be obtained from existing descriptions and figures for these species. The resultant minimum spanning tree (Fig. 6) indicates that *P. divisa* has its closest phenetic affinity (*sensu* Farris, 1967) with *P. purcellana*, although the latter species is also phenetically equidistant from *P. sara* and *P. cercia*. It is interesting to note that three clusters of phenetically closely related species pairs can be discerned each with one member from North America and one from Asia: *P. sara* - *P. cercia*; *P. forcipata* - *P. orientalis*; *P. vershina* - *P. zapikinae*. A consistency index of 0.63 indicates a moderate correlation between the tree and the data. The homoplasious evolutionary transitions are found to occur in characters 3 through 7. Obviously these provisional results must be viewed with caution as they could be substantially altered when characters, other than just those of the cerci and paraproct, are obtained and analyzed.

Finally, while it has been possible to place "*Leuctra*" *divisa* within *Paraleuctra*, four other species, three described by Okamoto (1922) and one described by Kawai (1967), remain problematical regarding their inclusion within this genus. Okamoto's descriptions and figures of *Leuctra forcifularis* (given uncertain species status by Illies, 1966) and *Rhopalopsole okamotoa* suggest, as noted by Zhiltzova (1975) and Zwick (1977) for the latter species, placement within *Paraleuctra*. On the other hand Okamoto's descriptions and figures of *Paraleuctra nipponica*, which Zhiltzova (1975) considered a species of *Rhopalopsole*, indicate that a more appropriate placement for this species might be within the genus *Perlomyia* (*sensu* Zwick, 1977). Lastly, the description and figure provided by Kawai for the female holotype of *Paraleuctra elongata* suggest that this species is possibly a member of *Rhopalopsole* (*sensu* Zwick, 1977). Resolution of the placement of these species as well as a detailed understanding of relationships of the species within *Paraleuctra* must await a thorough examination of all the considered species.

Descriptions of characters. — Fifteen characters were selected to undertake the preliminary analysis of the phyletics of *P. divisa* and closely related species. All the characters are two-state and are coded as follows: (1) Remainder of second cercal

segment: present = 0; absent = 1. (2) Two arms arising from basal cercal area: absent = 0; present = 1. (3) Upper arm with projection of posterior surface: absent = 0; present = 1. (4) Upper arm with two or more tooth-like projections at apex: absent = 0; present = 1. (5) Length of lower arm compared to length of upper arm: $2/3$ length or less = 0; nearly equal in length = 1. (6) Lower arm with projection on mesal surface: absent = 0; present = 1. (7) Lower arm apical margin: rounded = 0; truncated = 1. (8) Basal area with distinct posterior margin between upper and lower arms: absent = 0; present = 1. (9) Basal area with small projection on posterior surface near base of upper arm: absent = 0; present = 1. (10) Basal area dorsoventral distance compared to anteroposterior distance: nearly equal in length = 0; approximately $1/2$ length = 1. (11) Length of distal region of outer lobes of paraproct: less than twice the length of the mesolongitudinal distance of ninth sternite = 0; greater than twice the length of the mesolongitudinal distance of ninth sternite = 1. (12) Apical area of distal region of outer lobes: not distinctly expanded = 0; distinctly expanded = 1. (13) Apical area of distal region of outer lobes: not distinctly lobed = 0; distinctly lobed = 1. (14) Size of upper lobe of apical area compared to size of lower lobe: nearly equal = 0; approximately twice the size - 1. (15) Upper lobe with small coiled filament: absent = 0; present = 1.

ACKNOWLEDGEMENTS

The author would like to thank Dr. Robert X. Schick of the California Academy of Sciences for the opportunity of examining the holotype of *Paraleuctra divisa*. The author would also like to acknowledge Dr. Richard E. Garth for his critical reading of the manuscript and The University of Tennessee-Chattanooga Academic Computing Center for their assistance with the HP-2000 used in this study.

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Table 1. Data Matrix consisting of the character states for the species of *Paraleuctra*.

Species	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
<i>P. sara</i>	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0
<i>P. forcipata</i>	1	1	0	0	1	1	0	1	1	0	0	0	0	0	0
<i>P. vershina</i>	1	1	1	0	1	0	0	0	0	1	0	0	0	0	0
<i>P. purcellana</i>	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0
<i>P. orientalis</i>	1	1	0	0	0	1	0	1	1	0	0	0	0	0	0
<i>P. zapekinae</i>	1	1	1	1	1	0	0	0	0	1	0	0	0	0	0
<i>P. cercia</i>	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0
<i>P. divisa</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>P. occidentalis</i>	1	1	0	0	0	0	0	0	0	0	1	1	0	0	0
<i>P. jewetti</i>	1	1	0	0	0	0	1	0	0	0	1	1	1	1	0
<i>P. rickeri</i>	1	1	0	0	0	0	1	0	0	0	1	1	0	0	0
<i>P. gracilis</i>	1	1	0	0	1	0	0	0	0	0	1	1	1	1	1